# D VENN DIAGRAMS

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A **Venn diagram** consists of a universal set $U$ represented by a rectangle, and subsets within it that are generally represented by circles.

**Example 5**

Self Tutor

Consider the set $S = \{2, 4, 6, 7\}$ within the universal set $U = \{x \mid x \leqslant 10,\ x \in \mathbb{Z}^+\}$.

**a** Draw a Venn diagram to show $S$.

**b** List the elements of the complement set $S'$.

**c** Find: **i** $n(S)$ **ii** $n(S')$ **iii** $n(U)$

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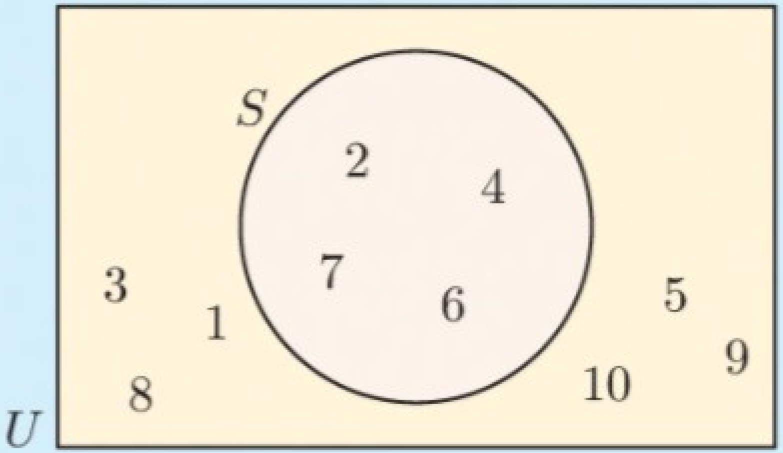
**a**



**b** $S' = \{1, 3, 5, 8, 9, 10\}$

**c** **i** $n(S) = 4$

**ii** $n(S') = 6$

**iii** $n(U) = 10$

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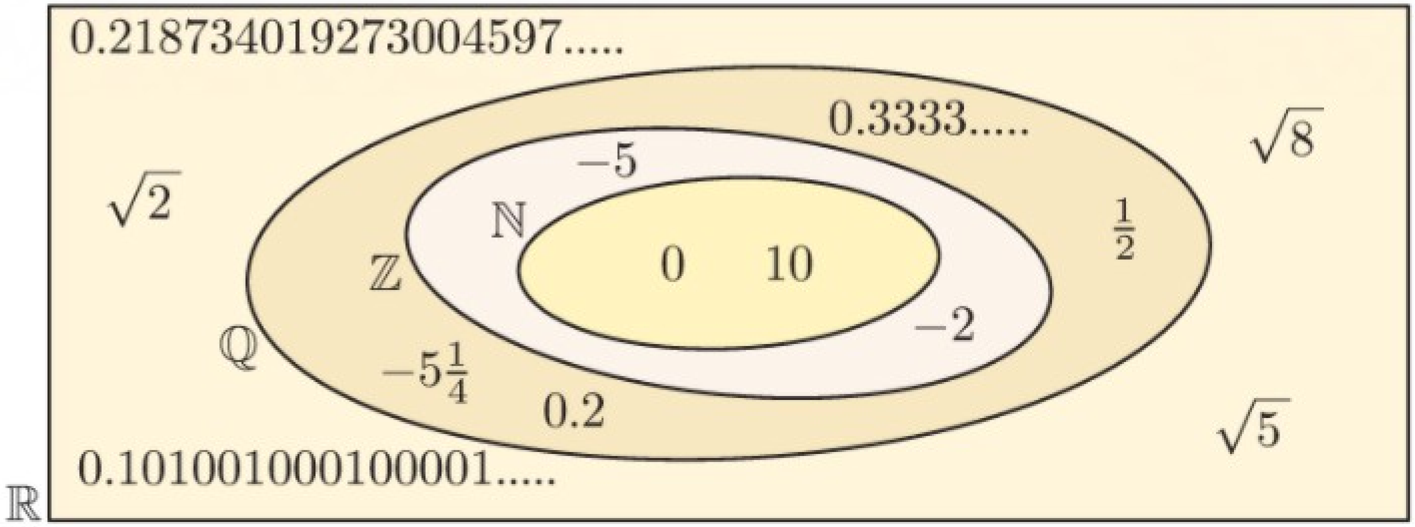

**Example 6** **Self Tutor**

Illustrate the following numbers on a Venn diagram:

$\sqrt{3}$, $8\frac{1}{2}$, $-2$, $7.1$, $16$, $0.115$

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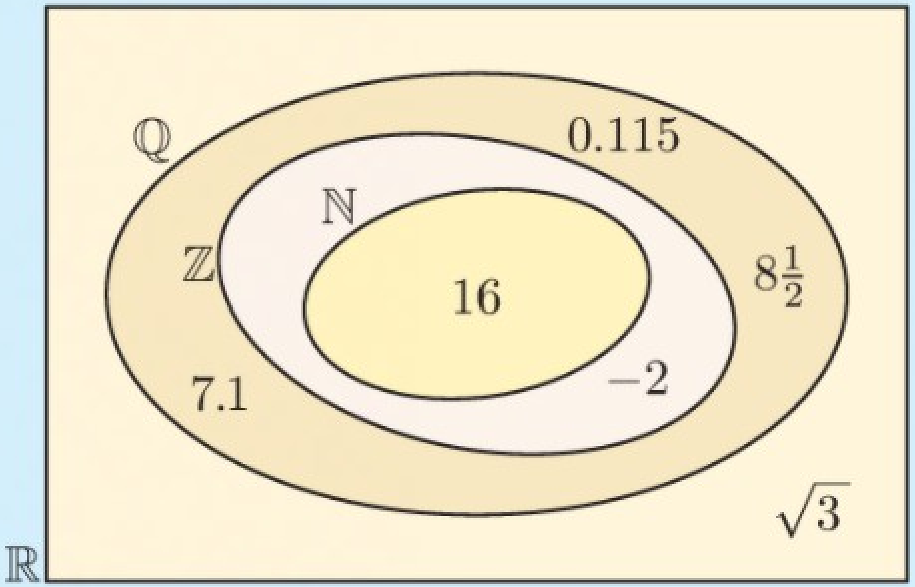

For two sets which have elements in common, we use circles which overlap.

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**Example 7** **Self Tutor**

Consider $U = \{x \mid 0 \leqslant x \leqslant 12,\ x \in \mathbb{Z}\}$, $A = \{2, 3, 5, 7, 11\}$, and $B = \{1, 3, 6, 7, 8\}$.

Illustrate $A$ and $B$ on a Venn diagram.

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**Example 7**

**Self Tutor**

Consider $U = \{x \mid 0 \leqslant x \leqslant 12,\ x \in \mathbb{Z}\}$, $A = \{2, 3, 5, 7, 11\}$, and $B = \{1, 3, 6, 7, 8\}$.

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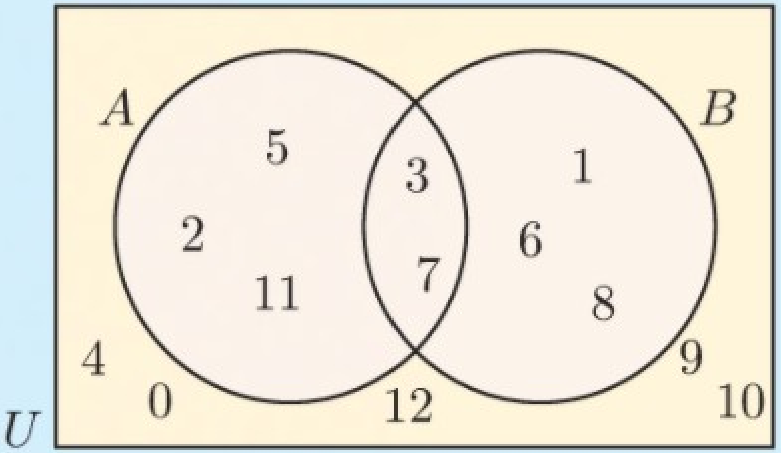


3 and 7 are in both $A$ and $B$, so the circles representing $A$ and $B$ must overlap.

We place 3 and 7 in the overlap, then fill in the rest of $A$ and the rest of $B$.

The remaining elements of $U$ are placed outside the two circles.

## EXERCISE 2D

**1** Suppose $U = \{x \mid x \leqslant 8,\ x \in \mathbb{Z}^+\}$ and $A = \{\text{prime numbers} \leqslant 8\}$.

**a** Show set $A$ on a Venn diagram. **b** List the set $A'$.

**c** Find: **i** $n(A)$ **ii** $n(A')$ **iii** $n(U)$

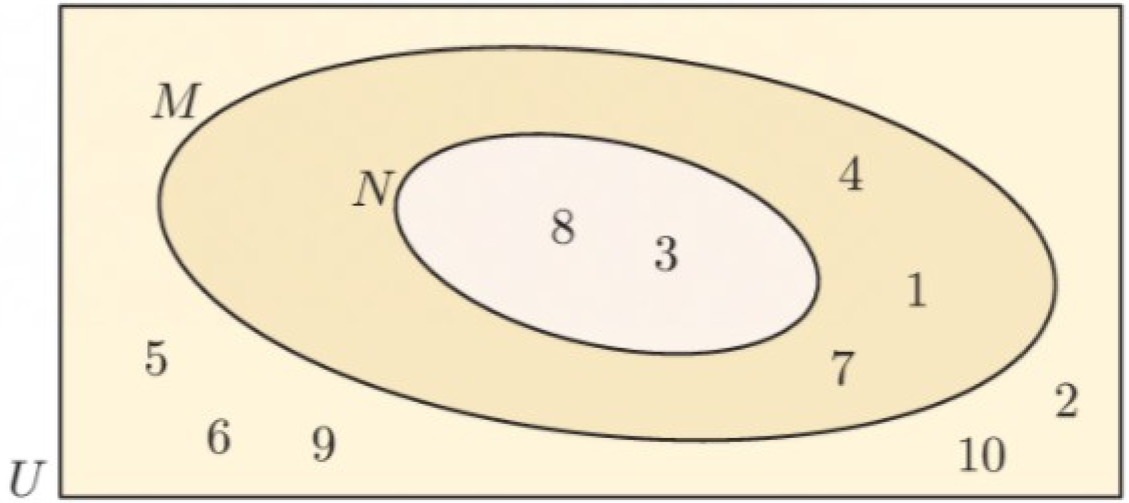
**2** Suppose $U = \{\text{letters of the English alphabet}\}$ and
$V = \{\text{letters of the English alphabet which are vowels}\}$.

**a** Show these sets on a Venn diagram.

**b** List the set $V'$.

**c** Find: **i** $n(V)$ **ii** $n(V')$ **iii** $n(U)$

**3**



**a** List the elements of:
**i** $U$ **ii** $N$ **iii** $M$

**b** Find $n(N)$ and $n(M)$.

**c** Is $M \subseteq N$?

**4** Illustrate $A$ and $B$ on a Venn diagram if:

**a** $U = \{1, 2, 3, 4, 5, 6\}$, $A = \{1, 2, 3, 4\}$, $B = \{3, 4, 5, 6\}$

**b** $U = \{4, 5, 6, 7, 8, 9, 10\}$, $A = \{6, 7, 9, 10\}$, $B = \{5, 6, 8, 9\}$

**c** $U = \{3, 4, 5, 6, 7, 8, 9\}$, $A = \{3, 5, 7, 9\}$, $B = \{4, 6, 8\}$

**5** Suppose the universal set is $U = \mathbb{R}$, the set of all real numbers.

$\mathbb{Q}$, $\mathbb{Z}$, and $\mathbb{N}$ are all subsets of $\mathbb{R}$.

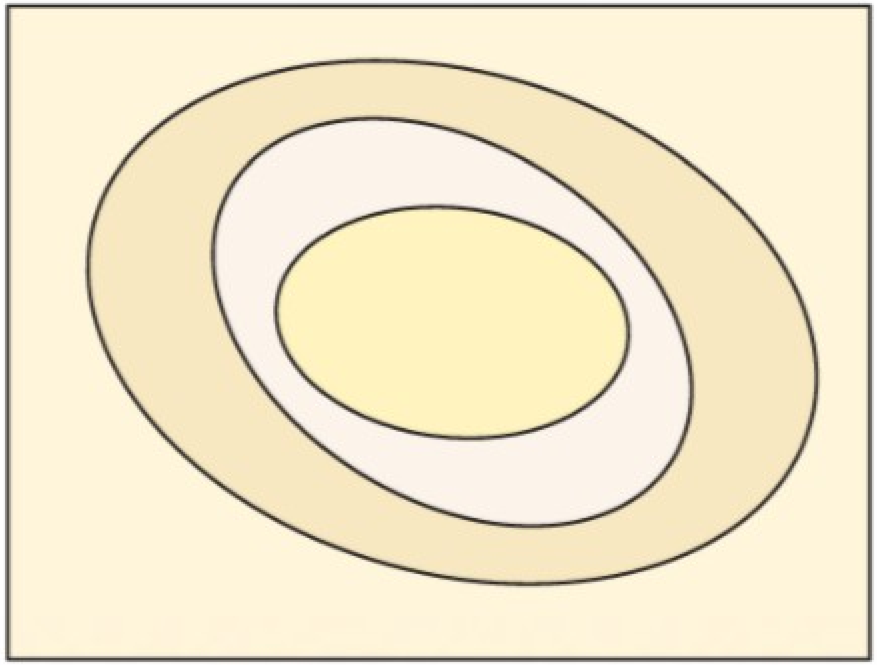
**a** Copy the given Venn diagram and label the sets $U$, $\mathbb{Q}$, $\mathbb{Z}$, and $\mathbb{N}$.

**b** Place these numbers on the Venn diagram:

$\frac{2}{3}$, $\sqrt{7}$, $0.\overline{4}$, $-1$, $-8\frac{1}{3}$, $0$, $4$, and

$\alpha = 0.564\,105\,923\,6\ldots.$ which does not terminate or recur.

**c** Shade the region representing the set of irrationals $\mathbb{Q}'$.



**6** Show the following information on a Venn diagram:

**a** $U = \{\text{triangles}\}$, $E = \{\text{equilateral triangles}\}$, $I = \{\text{isosceles triangles}\}$

**b** $U = \{\text{quadrilaterals}\}$, $P = \{\text{parallelograms}\}$, $R = \{\text{rectangles}\}$

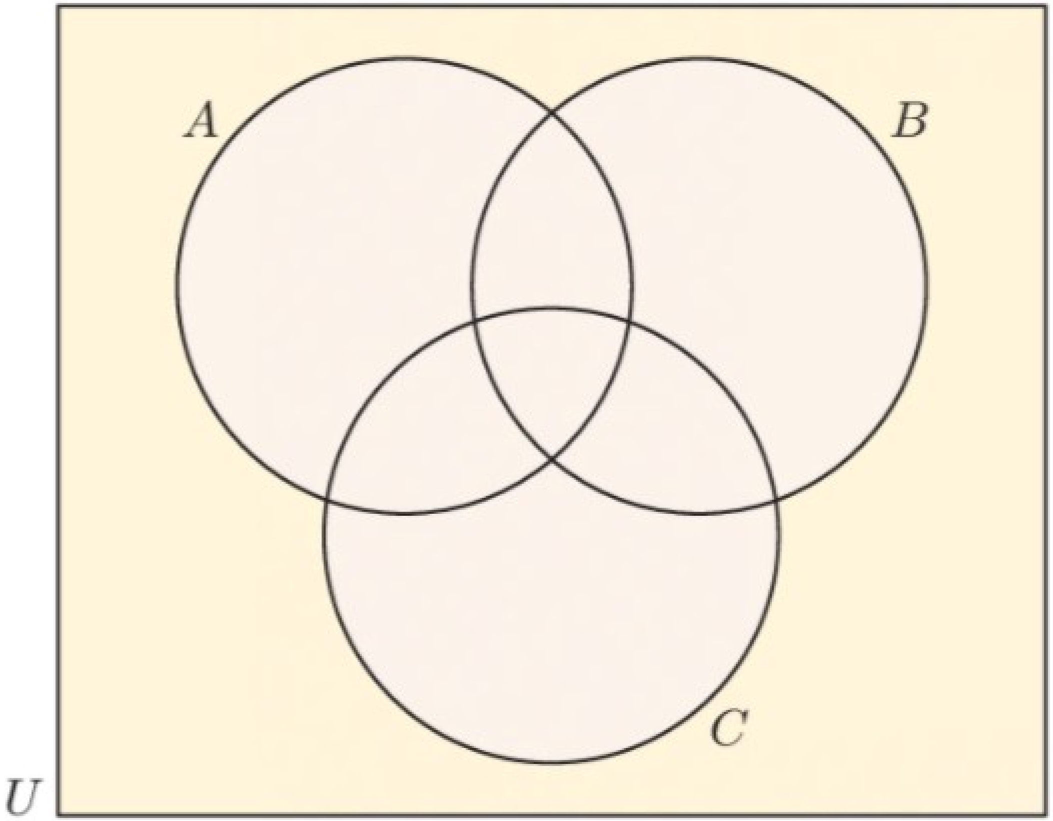
**7** Suppose $U = \{x \mid x \leqslant 30,\ x \in \mathbb{Z}^+\}$,

$A = \{\text{prime numbers} \leqslant 30\}$,

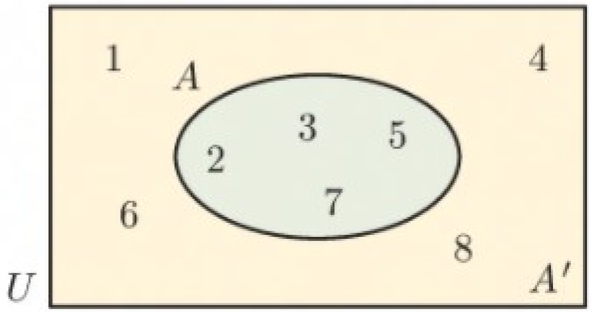
$B = \{\text{multiples of } 5 \leqslant 30\}$,

and $C = \{\text{odd numbers} \leqslant 30\}$.

Use the Venn diagram shown to display the elements of the sets.



**1** **a**



$A = \{2, 3, 5, 7\}$

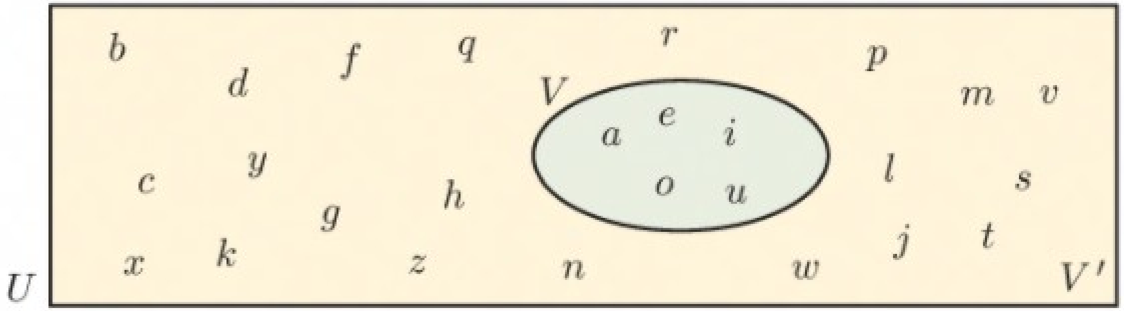
**b** $A' = \{1, 4, 6, 8\}$

**c** **i** $n(A) = 4$

**ii** $n(A') = 4$

**iii** $n(U) = 8$

**2** **a**



**b** $V' = \{b, c, d, f, g, h, j, k, l, m, n, p, q, r, s, t, v, w, x, y, z\}$

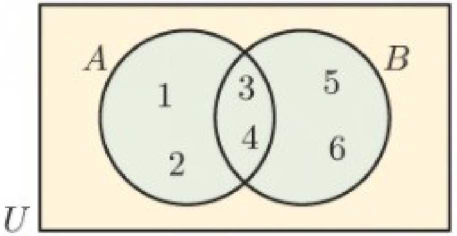
**c** **i** $n(V) = 5$ **ii** $n(V') = 21$ **iii** $n(U) = 26$

**3** **a** **i** $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

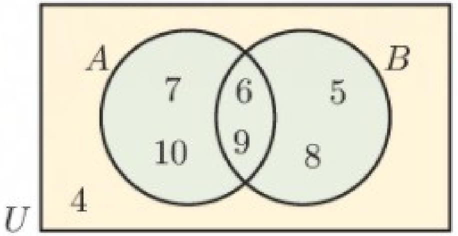
**ii** $N = \{3, 8\}$ **iii** $M = \{1, 3, 4, 7, 8\}$

**b** $n(N) = 2, \quad n(M) = 5$ **c** No, $N \subseteq M$.

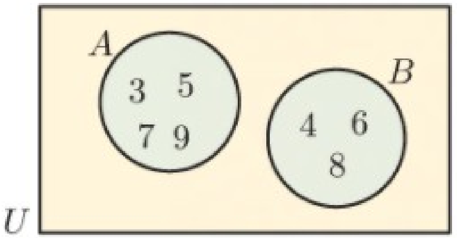
**4** **a**



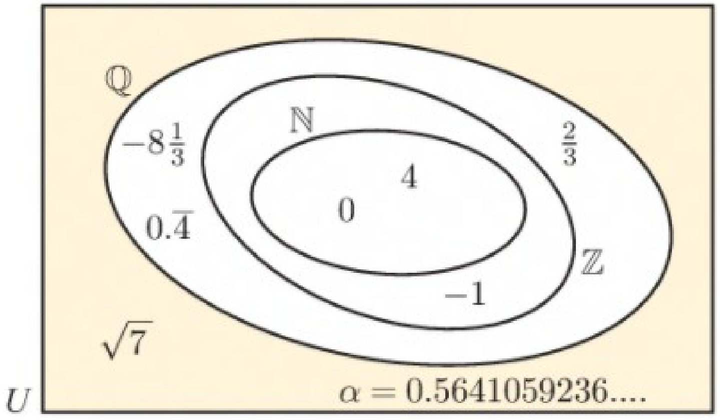
**b**



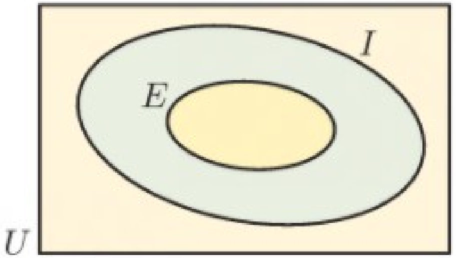
**c**



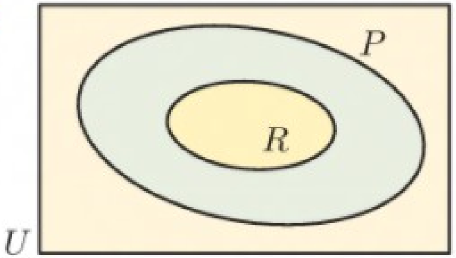
**5** **a**, **b**, **c**



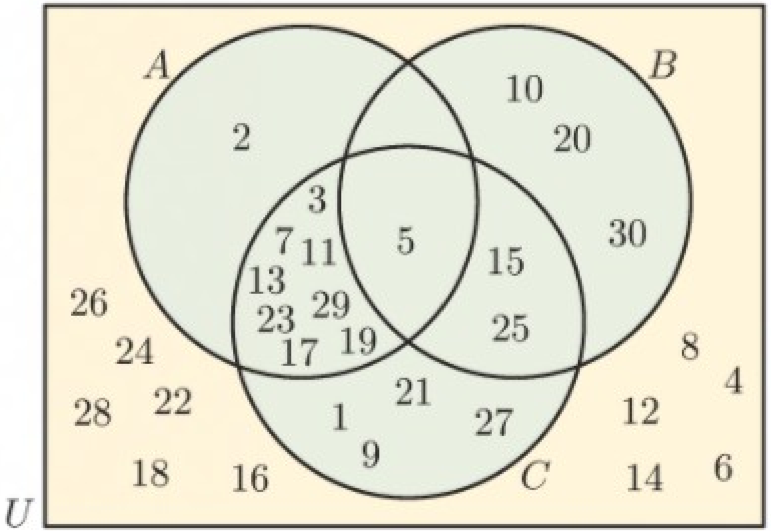
**6** **a**



**b**



**7**



A
B
C
U